

Program Description I

Program Title 67 - FAST FACTOR FINDER WITH AUTOMATIC ANSWER ACCUMULATION

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Program Description, Equations, Variables This program is especially suitable for the unattended factoring of large integers on the HP-67. To increase factoring speed, after the initial 4 primes are tested, only 8 potential factors out of every 30 are tested (i.e., 1, 7, 11, 13, 17, 19, 23, and 29 Modulo 30). As factoring proceeds, the potential factors get larger, and the integer being factored gets smaller; when the square of the potential factor becomes greater than the integer, all factors have been found. The factor test routine and other short routines are repeated where needed instead of made into subroutines to increase the program speed.

To extend the range of integers that can be factored by five times, a "false factor" test is used, and false factors are ignored. False factors may occur when factoring integers between 2×10^9 and 10^{10} because there is no room in the register for a decimal remainder after the integer is divided by a potential factor.

Registers 1 through 10 are used to accumulate the factors that are found. When the last factor is found, the program stops, displaying it as a negative number. If a factor occurs more than once in the integer being factored, the power of that factor is accumulated in the same register with the factor as units of 0.01 to indicate the number of times that factor occurs. The display routine automatically adjusts the display to show these powers when they occur.

Operating Limits and Warnings

Illegal entries (negative, zero, non-integer, or greater than 9,999,999,999) cause the program to stop with an "Error" signal.

Large integers that are prime, or that contain large prime factors, may require up to several hours to factor.

This program has been verified only with respect to the numerical example given in *Program Description II*. User accepts and uses this program material AT HIS OWN RISK, in reliance solely upon his own inspection of the program material and without reliance upon any representation or description concerning the program material.

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01602D Program Description II

Sketch(es)

Sample Problem(s) Factor the following numbers:

1. 60,037
2. 6,700,417
3. 1,999,999,983
4. 6,227,020,800 (13!)
5. 6,469,693,230 (Product of first 10 prime numbers)
6. 8,589,934,592 (2^{33})
7. 9,999,999,999

Solution(s)

Time, seconds

Problem

Factors

This Program

00063D

1.	60,037 is prime	33	59
2.	6,700,417 is prime	336	604
3.	$3 \times 19 \times 23 \times 151 \times 10,103$	25	47
4.	$2^{10} \times 3^5 \times 5^2 \times 7 \times 11 \times 13$	28	Can't do it
5.	$2 \times 3 \times 5 \times 7 \times 11 \times 13 \times 17 \times 19 \times 23 \times 29$	15	Can't do it
6.	2^{33}	45	Can't do it
7.	$3^2 \times 11 \times 41 \times 271 \times 9091$	42	Can't do it

Reference(s) Eric Isaacson HP-65 Users' Library program No. 00253A

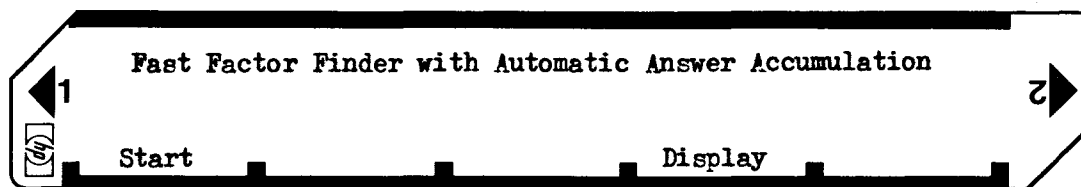
Mike Louder 65 Notes Vol. 3 No. 4 p. 14 (May 1976)

James J. Davidson 65 Notes Vol. 3 No. 9 pp. 9, 10 & 45 (Oct. - Nov. 1976)

James J. Davidson 65 Notes Vol. 4 No. 6 pp. 20 & 61 (July - August 1977)

J. L. Horn 65 Notes Vol. 4 No. 10 p. 33 (December 1977)

HP Math Pac MA1 - 01A (Users' Library program No. 00063D)

[illegible]

STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS
001	* LBL A	31 25 11	Start:		GSB 1	31 22 01	Yes
	EEX	43			2	02	
	1	01			STO + 0	33 61 00	Increment D
	0	00		060	RCL E	34 15	
	$x \leq y?$	32 71	Entry too large?		RCL 0	34 00	
	GTO E	22 15	Yes, "Error"		\div	81	
	CLx	44			FRAC	32 83	
	$x \neq y$	35 52			$x=0?$	31 51	Is 13 Mod 30 factor?
	$x \leq y?$	32 71	Entry 0, negative?		GSB 1	31 22 01	Yes
010	GTO E	22 15	Yes, "Error"		4	04	
	ENTER	41			STO + 0	33 61 00	Increment D
	INT	31 83			RCL E	34 15	
	$x \neq y?$	32 61	Entry non-integer?		RCL 0	34 00	
	GTO E	22 15	Yes, "Error"	070	\div	81	
	CL REG	31 43			FRAC	32 83	
	P \rightarrow S	31 42			$x=0?$	31 51	Is 17 Mod 30 factor?
	CL REG	31 43			GSB 1	31 22 01	Yes
	STO E	33 15	Store Entry, 1st N		2	02	
	2	02			STO + 0	33 61 00	Increment D
020	STO 0	33 00	Store 2, 1st trial		RCL E	34 15	
	\div	81	divisor, D		RCL 0	34 00	
	FRAC	32 83			\div	81	
	$x=0?$	31 51	Is 2 a factor?		FRAC	32 83	
	GSB 1	31 22 01	Yes	080	$x=0?$	31 51	Is 19 Mod 30 factor?
	1	01			GSB 1	31 22 01	Yes
	STO + 0	33 61 00	Increment D		4	04	
	RCL E	34 15			STO + 0	33 61 00	Increment D
	RCL 0	34 00			RCL E	34 15	
	\div	81			RCL 0	34 00	
030	FRAC	32 83			\div	81	
	$x=0?$	31 51	Is 3 a factor?		FRAC	32 83	
	GSB 1	31 22 01	Yes		$x=0?$	31 51	Is 23 Mod 30 factor?
	2	02			GSB 1	31 22 01	Yes
	STO + 0	33 61 00	Increment D	090	6	06	
	RCL E	34 15			STO + 0	33 61 00	Increment D
	RCL 0	34 00			RCL E	34 15	
	\div	81			RCL 0	34 00	
	FRAC	32 83			\div	81	
	$x=0?$	31 51	Is 5 a factor?		FRAC	32 83	
040	GSB 1	31 22 01	Yes		$x=0?$	31 51	Is 29 Mod 30 factor?
	2	02			GSB 1	31 22 01	Yes
	STO + 0	33 61 00	Increment D		2	02	
	RCL E	34 15			STO + 0	33 61 00	Increment D
	RCL 0	34 00		100	RCL E	34 15	
	\div	81			RCL 0	34 00	
	FRAC	32 83			\div	81	
	$x=0?$	32 51	Is 7 a factor?		FRAC	32 83	
	GSB 1	31 22 01	Yes		$x=0?$	31 51	Is 1 Mod 30 factor?
	* LBL 0	31 25 00	Mod 30 Loop Reentry		GSB 1	31 22 01	Yes
050	4	04			6	06	
	STO + 0	33 61 00	Increment D		STO + 0	33 61 00	Increment D
	RCL E	34 15			RCL E	34 15	
	RCL 0	34 00			RCL 0	34 00	
	\div	81		110	\div	81	
	FRAC	32 83			FRAC	32 83	
	$x=0?$	31 51	Is 11 Mod 30 factor?		$x=0?$	31 51	Is 7 Mod 30 factor?

REGISTERS

0 Trial Divisor	1 Factor	2 Factor or Zero	3 Factor or Zero	4 Factor or Zero	5 Factor or Zero	6 Factor or Zero	7 Factor or Zero	8 Factor or Zero	9 Factor or Zero
S0 Factor or Zero	S1 Zero	S2	S3	S4	S5	S6	S7	S8	S9
A		B		C		D		E N _i , current No. being factored	
								Factor Index	

STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS
	GSB 1	31 22 01	Yes		1	01	
	RCL 0	34 00		170	x=y	35 52	
	LST x	35 82			ISZ	31 34	(Never skips)
	x>y?	32 81	Is $D^2 > N_i$?		x=y?	32 61	Last factor is 1?
	GTO 0	22 00	No, continue		STO (i)	33 24	No, store it
	RCL E	34 15	Yes, factoring done		x=y?	32 51	Last factor is 1?
	ISZ	31 34	(Never skips)		LST x	35 82	Yes, previous fact.
120	STO (i)	33 24	Store last factor		CHS	42	
	CHS	42			R/S	84	Show last factor
	R/S	84			* LBL 4	31 25 04	Increment power of
	* LBL 1	31 25 01	Subroutine to handle		EEX	43	last factor
	RCL E	34 15	all factors	180	2	02	
	RCL 0	34 00			CHS	42	
	LST x	35 82			STO + (i)	33 61 24	
	X	71			F? 2	35 71 02	First pass?
	x=y?	32 61	False factor?		STO + (i)	33 61 24	Yes
	RTN	35 22	Yes, ignore it		RCL E	34 15	
130	LST x	35 82	No, continue		CHS	42	
	STO E	33 15	N/D becomes new N_i		R/S	84	Show last factor
	RCL 0	34 00			* LBL D	31 25 14	Display Routine:
	ISZ	31 34	(Never skips)		0	00	
	STO (i)	33 24	Store factor	190	ST I	35 33	
	x ²	32 54			CF 3	35 61 03	
	SF 2	35 51 02			* LBL 5	31 25 05	Display Loop
	x>y?	32 81	Is $D^2 > N_i$?		ISZ	31 34	(Never skips)
	GTO 2	22 02	Yes, factoring done		RCL (i)	34 24	
	* LBL 3	31 25 03	No, continue		x=0?	31 51	All factors shown?
140	RCL E	34 15			GTO 6	22 06	Yes, end display
	RCL 0	34 00			FRAC	32 83	No, continue
	÷	81			x≠0?	31 61	Factor has power?
	FRAC	32 83			SF 3	35 51 03	Yes
	x≠0?	31 61	Is D still factor?	200	RC I	35 34	Show factor index #
	RTN	35 22	No, try next factor		PAUSE	35 72	
	RCL E	34 15	Yes, continue		LST x	35 82	
	RCL 0	34 00			F? 3	35 71 03	Factor has power?
	LST x	35 82			DSP 2	23 02	Yes, set display
	X	71			-x-	31 84	Show factor
150	x=y?	32 61	False factor?		DSP 0	23 00	
	RTN	35 22	Yes, ignore it		GTO 5	22 05	Loop, next factor
	EEX	43	No, continue		* LBL 6	31 25 06	End display
	2	02			LST x	35 82	
	CHS	42		210	CHS	42	
	STO + (i)	33 61 24	Incr. factor power		RTN	35 22	Show last factor
	F? 2	35 71 02	First pass?				
	STO + (i)	33 61 24	Yes, make 2nd power				
	LST x	35 82					
	STO E	33 15	N/D becomes new N_i				
160	RCL 0	34 00					
	x ²	32 54					
	x≤y?	32 71	Is $D^2 > N_i$?				
	GTO 3	22 03	No, try D again				
	* LBL 2	31 25 02	Yes, factoring done	220			
	RCL 0	34 00					
	RCL E	34 15					
	x=y?	32 51	Does D equal N_i ?				
	GTO 4	22 04	Yes increment power				

LABELS					FLAGS	SET STATUS		
A Start	B	C	D Display	E "Error"	0	FLAGS	TRIG	DISP
a	b	c	d	e	1	ON OFF		
						0 <input type="checkbox"/> <input type="checkbox"/>	DEG <input type="checkbox"/>	FIX <input checked="" type="checkbox"/>
0 Loop	1 Subroutine	2 Done	3 Try again	4 Δ Power	2 1st Pass	1 <input type="checkbox"/> <input type="checkbox"/>	GRAD <input type="checkbox"/>	SCI <input type="checkbox"/>
5 Dspl Loop	6 End Dspl.	7	8	9	3 Set Dspl	2 <input type="checkbox"/> <input checked="" type="checkbox"/>	RAD <input type="checkbox"/>	ENG <input type="checkbox"/>
						3 <input type="checkbox"/> <input checked="" type="checkbox"/>		n_0